Plaintiffs' Exhibit 32
(Redacted)

IN THE UNITED STATES DISTRICT COURT

FOR THE EASTERN DISTRICT OF VIRGINIA

Alexandria Division

UNITED STATES, et al.,	)	
	)	
Plaintiffs,	)	
v.	)	No. 1:23-cv-00108-LMB-JFA
	)	
GOOGLE LLC,	)	
	)	
Defendant.	)	

DECLARATION OF GABRIEL WEINTRAUB
IN SUPPORT OF PLAINTIFFS' OPPOSITION TO
GOOGLE'S MOTION FOR SUMMARY JUDGMENT

Gabriel Weintraub, PhD., being duly cautioned, declares as follows:

1. I am over 21 years old and am competent to testify about the matters in this Declaration based on my personal knowledge.
2. Attached hereto as Exhibit A is a true and correct copy of the December 22, 2023, Expert Report of Gabriel Weintraub, PhD, along with associated errata. Attached hereto as Exhibit B is a true and correct copy of the February 13, 2024, Expert Rebuttal Report of Gabriel Weintraub, PhD, along with associated errata.
3. I authored the attached Expert Reports identified in Item (2) above and understood at the time I signed them that they were being prepared for use in this litigation. I am prepared to testify at trial, under oath, to the matters set forth in these reports. My statements set forth in these reports, as modified by associated errata, are true and correct to the best of my knowledge.
4. The exhibits attached to the reports described in Item (2) are true and correct copies.

I declare under penalty of perjury under the laws of the United States of America that the foregoing statements in this Declaration are true and correct.

Dated:

Signed:

Gabriel Weintraub, PhD.

City and Country:

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF VIRGINIA
ALEXANDRIA DIVISION

United States of America, *et al.*,

Plaintiffs,

v

Google LLC,

Defendant.

Case No. 1:23-cv-00108

HON. LEONIE H. M. BRINKEMA

EXPERT REPORT OF

GABRIEL WEINTRAUB, PH.D.

DECEMBER 22, 2023

211. Lastly, as I discuss next in Section VI.C.1, Google implemented a program called Project Poirot, which reduced DV360's bids into exchanges that "deviate from second pricing," starting in 2017.[491] As discussed above, in the dynamic region, AdX used sell side dynamic revenue sharing to charge advertisers a different amount depending on their exact bids. As a result, AdX was not a true second price auction due to sell side dynamic revenue sharing, and absent alterations to sell side dynamic revenue sharing or Project Poirot, the former may have triggered Project Poirot to shade DV360's bids into AdX. However, Google implemented sell side dynamic revenue sharing in a way that AdX could avoid triggering Project Poirot, which would have resulted in DV360 reducing its bids submitted to AdX as well. In particular, Google documents indicate that around 2016, Google "remove[d]" DV360 from Sell Side DRS V1, and that Google did not plan to activate Sell Side DRS V2 for DV360.[492] Further, Google documents indicate that tDRS's design specifically "restore[d] per-query truthfulness" and thus "allowed" DRS to be applied to DV360 again.[493] Google's integration between the sell side and buy side was critical to execute these strategies. Furthermore, without knowing the details of both sell side dynamic revenue sharing and Project Poirot, Google's rivals did not have the same opportunity to work around Project Poirot in their auction design.

VI.B.2. Impact of Google's Sell Side Dynamic Revenue Sharing on Rival Exchanges' Scale

212. Google's internal analyses primarily focused on the effects of sell side dynamic revenue sharing on AdX (implemented in conjunction with last-look) and documented increases in AdX's revenue in particular. Examples of the results of Google's internal analyses include:

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491 GOOG-DOJ-10806862, at -862 (04/25/2017) ("The goal of Poirot is to discover the exchanges that deviate from second pricing and bid appropriately on these to improve advertiser performance on these exchanges."); *see also*, Ravi Report, Section III.D.2.a.

492 GOOG-DOJ-14734878, at -878 (11/09/2016) ("Launch information…Remove DBM from AdX dynamic revshare…Launch Date[:] 2016-10-26…We would like to remove DBM from existing AdX dynamic revshare v1 (and future v2). DBM does not plan to participate dynamic revshare v2."); *see also*, GOOG-AT-MDL-012340434, at -434 (11/28/2016) (Email notification showing that the "Remove DBM from AdX dynamic revshare" functionality did in fact launch.).

493 GOOG-AT-MDL-009026446, at -452–453 (10/08/2019) ("Rita conduced [sic] a major-rewrite of the system making [tDRS] MachineLearning-based to restore per-query truthfulness. In the process, it was possible to apply it also to GDN demand resulting in +$27M/year revenue."); *see also*, GOOG-DOJ-14743636, at -637 (12/07/2017) ("The updated DRS behavior will also allow us to apply the feature to Adwords and DBM.").

- Experimental results from November 2014 predicted that in the absence of Project Bernanke,[494] Sell Side DRS V1[495] would raise AdX's advertiser spend by 12.08 percent or 9.48 percent when focused on AdX buyers—i.e., AdX bids from demand sources except Google Ads—specifically.[496]
- In a 2016 slide deck on Sell Side DRS V2, Google claimed that the feature raised overall AdX and publisher revenue (including remnant) by 3.54 percent and 2.80 percent, respectively.[497]
- A "Launch Doc" on Sell Side DRS V2 reported post-launch effects of both Sell Side DRS V1 and V2 relative to no DRS.[498] Among a subset of traffic on AdX known as AdX Buyers,

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494 Project Bernanke was a dynamic revenue sharing program run by Google Ads on its bids into AdX, where it lowered its margin on some bids to subsidize other bids, resulting in higher winrates for its advertisers on AdX. *See* Ravi Report, Appendix D.2; *see also*, GOOG-DOJ-11810183, at -189 (08/28/2013) ("With Bernanke, we seek to win even more AdX auctions by taking *negative* buyside margin on competitive AdX auctions – effectively increasing GDN's top bid into AdX beyond the advertiser's willingness to pay.").

495 In this version of Sell-Side DRS, Google allowed AdX's margin on a given auction to fall below 20 percent, but did not raise it above 20 percent. *See* GOOG-DOJ-07330182, at -182–184 (11/2016) ("**Original AdX auction (fixed margin)**…**Current AdX Auction: Post Dynamic revenue share[:]**…AdX DRS still clears the transaction, but with a reduced margin (as low as 0% and as high as 20%)…Whenever possible, AdX will take the full 20% margin, and the margin reduction is only applied when AdX can't get the full 20%. This means that the effective margin is lower than 20% (today it is around 18%).") (emphasis in original).

496 GOOG-DOJ-14712011, at -014 (12/04/2014) ("Experiment data dates: 11/1-11/4…**DRS Without Bernanke (experiment results)**[:] Gross revenue lift %[:] 9.48% [on]…AdX buyers…13.39% [on]…AdWords buyers…12.08% [on] Total [all traffic]…**DRS with anticipated Bernanke reaction (based on assumptions)**[:] Gross revenue lift %[:] 9.00% 1…1) AdX buyer gross revenue lift…8.00% 2…2) AdWords buyer gross revenue lift…8.33% [on] Total [all traffic]") (emphasis in original). The experimental results reported above are "DRS Without Bernanke," i.e., Sell-Side DRS without the simultaneous implementation of Buy-Side DRS. Notably, based on the Google team's assumptions of the "anticipated Bernanke reaction," Google anticipated that implementing both Sell-Side DRS and Buy-Side DRS on the same impressions would yield a smaller increase in AdX revenue than if Sell-Side DRS was implemented without Buy-Side DRS.

497 GOOG-DOJ-13235100, at -101 (04/11/2016) ("DRS consistently makes publishers more money. Overall Impact: **+2.80%** lift in publisher revenue (including remnant)...**+3.54%** lift in Google (AdX) revenue") and at -102 ("[There is a] lift of DRS v2 (half-way with buy/pub side recollection) compared with no-DRS, since all the numbers in the deck are DRSv2 vs no-DRS.") and at -103 ("**Calculating Publisher Revenue**[:] Publisher Revenue = **AdX Revenue + Third-party Network Revenue**[.] Third-party Network revenue = Sum(**remnant_cpms**) on queries unmatched by AdX, but served by remnant…Overall impact of DRS [v2]: **+ 2.80%** publisher revenue increase [relative to no DRS].") (Emphasis in original). Note that Google Ad Manager considers network, bulk, and price priority as remnant line items. *See also*, "Line item types and priorities," Google Ad Manager Help, Google, accessed December 17, 2023, https://support.google.com/admanager/answer/177279 ("House line items only serve when no remnant line items (Network, Bulk, Price Priority), Ad Exchange or Open Bidding demand are available to serve.").

498 GOOG-DOJ-AT-02421520, at -520 ("AdX Dynamic Revshare v2: Launch Doc…ariane/145022") and -523 ("RevShareVersionTwo::DRSv2Experiment…Comparison with the no-DRS holdback[:] Effect of DRS v1 on the holdback just before the v2 launch."). This design doc is referred to in other internal documents, indicating

Sell Side DRS V2 increased impressions won by 7.26 percent and advertiser spend on AdX by 9.98 percent.[499]

- In a document describing his contributions at Google in 2016, Nirmal Jayaram highlighted that sell side dynamic revenue sharing "[l]aunched for +$110M."[500] His summary of his accomplishments and impact again noted that sell side dynamic revenue sharing "generated over $100M in spend."[501]

213. As discussed above, Google's internal analyses found that sell side dynamic revenue sharing programs increased advertiser spend on AdX and its volume of impressions won. AdX's increase would imply a decrease in the impressions won by third-party exchanges if the winning bid on AdX exceeded the bid on a third-party exchange, as opposed to clearing the publisher's floor or the reserve price of the auction.

214. As I did in Sections VI.A.2 ("last look"), I use Google's experiments to estimate the potential effect of sell side dynamic revenue sharing on rival exchange scale. When Google launches a new feature, Google can create a "holdback" sample, which is a fixed percentage of traffic that

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that the Sell Side DRS v2 launch was likely in Q1 2016. *See also*, GOOG-AT-MDL-004043558, at -558 (01/14/2016) ("Launch ID[:] 145022[,] Name[:] **Dynamic Revshare v2 on Ad Exchange for AdX Buyers**…Launch Date[:] **2016-Q1**[,] Status[:] **Current**…Description[:] In AdX Dynamic Revshare (DRS) v2 we address the issue of AdX margin loss in v1. In v1 the per-query AdX mar[g]in ranges [were] [0%, 20%], resulting [in] average adx margin [being] lower than standard 20%. In v2 we expand per-query margin range to be [0%, >20%], with an objective to keep average adx margin at 20% over queries. The scope of this launch is limited to AdX buyers.") (emphasis in original).

499 GOOG-DOJ-AT-02421520, at -523 ("Effect on [sic] DRS v2 on the holdback (just after launch)…AdX Only * Adx Buyer[:]…Impressions[:] 7.26%…Revenue[:] 9.98%"). Note that "Adx Only * AdX Buyer" likely corresponds to a subset of third-party buyers purchasing traffic through AdX. *See also*, Deposition of Jason Hsueh (Google), November 15, 2023, 37:2–11 ("Q. Let me rephrase. What does the tag AdX only mean? A. Oh. AdX only would refer to -- I believe that's typically looking at AdX publishers. Q. What would AdX buyer mean, even if it's not on this page? A. That would be referring to third-party buyers who are other DSPs outside of Google who are purchasing traffic through the AdExchange."). Additionally, AdX Buyers can include DV360 traffic. *See also*, GOOG-AT-MDL-009013515, at -515 (08/2016) ("There is also an impact on Adx buyers since some Adx buyers are still counted as DBM buyers by rasta"). Note that in holdback experiments, the treatment group in RASTA is the sample without conduct and the control group is the sample with the conduct. *See also,* GOOG-AT-MDL-002207287, at -310 (06/2017) ("[T]his is important because Holdback stats are typically reversed (eg, holdback will show -0.3%RPM due to the ordering of control vs experiment IDs)").

500 GOOG-AT-MDL-B-001601271, at 273 ("Sell-side dynamic revshare: [l]aunched for +$100M revenue.") (emphasis in original).

501 GOOG-AT-MDL-B-001601271, at 278 ("Sell-side dynamic revshare, which I worked on in collaboration with Adx engineers, generated over $100M in spend.").

does not adopt the new feature. Such a holdback sample allows Google to monitor the performance of a new feature after launch over a period of time.[502] Google monitors performance by comparing key metrics between traffic in "production," which adopted the new feature, with the holdback sample, which did not.[503]

215. Among the experiments related to sell side dynamic revenue sharing, an experiment where Google evaluated the size of the holdout sample sheds light on the impact of sell side dynamic revenue sharing on rival exchanges' scale. Documents show that at least since late 2016 Google used 10 percent of traffic as the holdback sample in running experiments to evaluate the effects of sell side dynamic revenue sharing, likely Sell Side DRS V2.[504] In late 2016, Google proposed reducing the size of this holdback sample from 10 percent to 5 percent and ran experiments to study its impact. One of these experiments reports the ad spend impact of Sell Side DRS V2 relative to the holdback sample (which was not affected by either Sell Side DRS V1 or V2).[505]

216. This experiment reports that the ad spend of the holdback sample, which focuses on AdX Buyers, was lower than the ad spend of the rest of the traffic by 7.9 percent.[506] Note that this effect is likely relative to a control group with no Sell Side DRS.[507] This experiment also reports

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[502] GOOG-AT-MDL-002207287, at -291 (06/2017) ("A holdback is a reverse experiment, ie, [sic] an experiment that is run after the launch, comparing it to pre-launch control. Metrics from holdbacks are more accurate than forward experiments.").

[503] GOOG-DOJ-AT-02421520, at -523 ("Effect on DRS v2 on the holdback (just after launch).").

[504] Internal Google communications discuss a 10 percent holdback sample for Sell-Side Dynamic Revenue Share. *See* GOOG-DOJ-15207227, at -227 (12/08/2016) ("Sent: 12/8/2016 8:54:10 PM").

Given that this change in the size of the holdback sample was proposed in December 2016, it is likely that this experiment was conducted while Google was running Sell-Side DRS V2; *see also*, GOOG-DOJ-15207227, at -227 (12/08/2016) (Internal Google communications discuss a 10 percent holdback sample for Sell-Side Dynamic Revenue Share). Sell-Side Dynamic Revenue Share version 2 operated from July 2016 to July 2018. *See also*, GOOG-TEX-00033540, at -540 (06/15/2016) ("[Indirect] Dynamic Rev Share v2 […] Feature flag launched and communicated 6/14, will take effect 07/06."); *see also*, GOOG-AT-MDL-008842393, at -403 (08/04/2023) ("tDRS, which launched in July 2018, adjusted AdX's revenue share before sending bid requests to AdX buyers.").

[505] GOOG-DOJ-AT-02427435, at -435 ("We would like to reduce the holdback traffic percentage for AdX dynamic revshare (DRS) to 10% from 5%."). Holdback sample for Sell Side DRS V2 did not apply DRS. *See* GOOG-DOJ-AT-02421520, at -523 ("Comparison with the no-DRS holdback…Effect on DRS v2 on the holdback (just after launch).").

[506] GOOG-DOJ-AT-02427435, at -435 ("Holdback Percentage… MatchedQueries… Revenue… 10% (existing)… **-6.24%**… **-7.90%**") (emphasis in original).

[507] Based on another experiment, holdback sample for SSDRS V2 is no DRS. *See* GOOG-DOJ-AT-02421520, at -523 ("Comparison with the no-DRS holdback").

the statistical significance of this impact through a confidence interval, and the confidence interval does not include zero, meaning that the impact is statistically significant.[508] This percentage implies that Sell Side DRS V2 would increase ad spend on AdX for AdX Buyers by 8.6 percent compared to no Sell Side DRS.[509]

217. As summarized in Table 3, I find that the 8.6 percent lift in AdX's advertiser spend translates into $161.6 million in annual advertiser spend based on AdX's observed advertiser spend in 2018. Had all of the increase in AdX's advertiser spend been shifted from rival exchanges as a result of Sell Side DRS V2, rival exchanges would have advertiser spend of $5.9 billion per year, which is the sum of actual annual advertiser spend of rival exchanges in 2018 ($5.7 billion) and $161.6 million, the amount lost due to Sell Side DRS V2.[510] Dividing $161.6 million by $5.9 billion, I estimate that rival exchanges would have lost 2.74 percent of their advertiser spend due to SSDRS V2 in 2018. For impressions, rival exchanges saw a decrease of 81.7 billion impressions, or 2.39 percent of annual impression volume absence the conduct.

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[508] GOOG-DOJ-AT-02427435, at -436. These confidence intervals are likely at 95% statistical significance. Elsewhere, Google indicates that confidence intervals shown by its experimental results portal are 95% confidence intervals. *See also*, GOOG-AT-MDL-003100822, at -862 (11/2022) ("**Confidence interval – ROUGH DEFINITION:** Given assumptions, it's 95% likely that the true result is in this range.") (emphasis in original); *see also*, GOOG-AT-MDL-009644232, at -232 (08/25/2023) ("Data settings… Best 95% CI…"); *see also*, Deposition of Jason Hsueh (Google), November 15, 2023, 51:22 –52:8 ("Q. Does 95 percent describe the confidence interval shown here? A. Yes. Q. Is that a standard setting in RASTA? A. Yes, I believe so. Q. So if a RASTA experiment used standard settings, the 95 -- excuse me, the confidence interval would be 95 percent; is that right? A. I believe that's the typical case, but I haven't looked at specifically that, that field.").

[509] *See* GOOG-DOJ-AT-02427435, at -435, which reports that the 10% holdback sample had -7.9% less revenues compared to production. This means SSDRS V2 had a $\frac{1}{1-0.079} - 1 = 8.6$ percent increase on no-DRS holdback sample. We believe the experimental estimate on SSDRS V2 from GOOG-DOJ-AT-02427435, at -435 is compared to no DRS. This is consistent with GOOG-DOJ-AT-02421520, at -523, which reports that the holdback sample for SSDRS V2 is no DRS. That doc also reports that SSDRS V2 increased revenues by 9.98 percent. This is close to the estimate we use from GOOG-DOJ-AT-02427435, at -435 of 6.58 percent.

[510] *See* Conduct Effects Workpaper, at tab Sell-side DRS.

TABLE 3: EFFECTS OF SELL SIDE DYNAMIC REVENUE SHARE ON RIVAL EXCHANGES

Experiment	Base Year		Annual Effect [A]	Percent Effect [B]
Effect on Impressions			(Billions)	
Sell-Side DRS V2, Including V1 Effect, Holdback Release, 10%	2018	[1]	-81.7	-2.39%
Effect on Gross Revenues (Ad Spend)			(Millions)	
Sell-Side DRS V2, Including V1 Effect, Holdback Release, 10%	2018	[2]	-$161.6	-2.74%
Sell-Side DRS V2, Pre-Launch Deck, All AdX	2018	[3]	-$154.2	-2.61%

Sources and Notes: Calculations using data from Professor Robin Lee's share calculations and data from RFP 7, RFP 54, and RFP 53. Worldwide coverage. Denominator of percent effects is implied but-for size of rival exchanges, leading to more conservative estimates. See Conduct Effects Workpaper, at tab "Table 3."

- [A]: Effect of conduct on annual number of impressions and amount of ad spend won by rival exchanges, based on the substitution from rival exchanges analysis.
- [B]: Percent effect of conduct on impressions and amount of ad spend won by rival exchanges, based on the substitution from rival exchanges analysis.
- [1] and [2]: GOOG-DOJ-AT-02427435, at -436 and GOOG-DOJ-15207227 (12/08/2016).
- [3]: GOOG-DOJ-13235100, at -102 (04/11/2016).

218. For Sell Side DRS V2 with the benefit of "last look," it is possible that AdX was able to clear some auctions that otherwise would not have been cleared. Table 4 shows the results of my analysis under the GAM June 2023 approach where rival exchanges collectively lost at least 11.3 billion impressions (or 0.34 percent of impressions in the absence of the conduct), or $30.7 million (or 0.53 percent of advertiser spending in the absence of the conduct) in connection with Sell Side DRS V2.

TABLE 4: EFFECTS OF SELL SIDE DYNAMIC REVENUE SHARE ON RIVAL EXCHANGES – GAM JUNE 2023 ANALYSIS

Experiment	Base Year		Annual Effect [A]	Percent Effect [B]
Effect on Impressions			(Billions)	
Sell-Side DRS V2, Including V1 Effect, Holdback Release, 10%	2018	[1]	-11.3	-0.34%
Effect on Gross Revenues (Ad Spend)			(Millions)	
Sell-Side DRS V2, Including V1 Effect, Holdback Release, 10%	2018	[2]	-$30.7	-0.53%
Sell-Side DRS V2, Pre-Launch Deck, All AdX	2018	[3]	-$29.3	-0.51%

Sources and Notes: Calculations using data from Professor Robin Lee's share calculations and data from RFP 7, RFP 54, and RFP 53. Worldwide coverage and basis for GAM June 2023 analysis. Denominator of percent effects is implied but-for size of rival exchanges, leading to more conservative estimates. See Conduct Effects Workpaper, at tab "Table 4."

- [A]: Effect of conduct on annual number of impressions and amount of revenues (ad spend) won by rival exchanges, assuming that the share of AdX wins on GAM where the second highest bidder is an identifiable rival exchange is the share displaced from rival exchanges.
- [B]: Percent effect of conduct on impressions and amount of revenues (ad spend) won by rival exchanges, assuming that the share of AdX wins on GAM where the second highest bidder is an identifiable rival exchange is the share displaced from rival exchanges.
- [1] and [2]: GOOG-DOJ-AT-02427435, at -436 and GOOG-DOJ-15207227 (12/08/2016).
- [3]: GOOG-DOJ-13235100, at -102 (04/11/2016).

219. Google's sell side dynamic revenue sharing in conjunction with "last-look" likely harmed advertisers by making suboptimal matches, in particular advertisers bidding through rival exchanges that are less likely to win. Specifically, sell side dynamic revenue sharing would yield suboptimal matches because AdX's buyer can win despite its lower valuation than a competing exchange's buyer. In addition, AdX's buyer can win because of AdX's last look advantage working through sell side dynamic revenue sharing and not because of its valuation of impressions. There could also be distributional effects for advertisers if some buyers tend to participate in more competitive auctions and others tend to participate in more non-competitive auctions.

VI.C. Google's Implementation of Project Poirot on DV360

VI.C.1. Google's Project Poirot and Its Incentives and Ability to Reduce DV360's Bids Submitted to Rival Exchanges

220. By the mid-2010s, Google believed that some exchanges had moved away from running "clean" second price auctions,[511] and that some were running non-transparent combinations of first- and second price auctions.[512] Recall that in first price auctions, it is optimal for bidders to reduce their bids (Section II.A.1). As of April 2017, Google employees had begun developing and proposed implementing "Project Poirot," a new project that would reduce bids from DV360 into rival exchanges that Google deemed to be non-clean second price auctions.[513]

221. Project Poirot was fully launched in July 2017,[514] and the program reduced bids from DV360 into rival exchanges that were identified as running non-second price auctions.[515] To implement the program, Google started running experiments where it would siphon off small pieces of DV360's traffic going to third-party exchanges and lower its advertiser's bids, using discrete multipliers to determine volume and costs of ad spend as a function of the bids.[516] That is,

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511 *See* Ravi Report, Section III.D.4.; *see also*, GOOG-AT-MDL-006218257, at -266 (12/16/2022) ("As many exchanges began to move from second-price to first-price auctions in the mid-to-late-2010s"); *see also*, GOOG-DOJ-10806862, at -862 (04/25/2017) ("Over half of DBM bidding goes through third-party exchanges, many of which do not run clean second price auctions. Fixed CPM bidders have the same bid in these unclean exchanges as they do in clean exchanges, which is suboptimal. The goal of Poirot is to discover the exchanges that deviate from second pricing and bid appropriately on these to improve advertiser performance on these exchanges.").

512 *See* Ravi Report, Section III.D.2.; *see also*, GOOG-AT-MDL-008842383, at -389 (08/05/2023) ("It was not always clear to advertisers (or Google) whether they were bidding into first or second-price auctions.").

513 *See* Ravi Report, Section III.D.4.; *see also*, GOOG-DOJ-12059682, at -682 (08/10/2018) ("Poirot is a framework for bid shaving in non-second-price auction exchanges. It only applies to fixed CPM DBM traffic…On 3PE (third party exchanges) we see an aggregate surplus increase of 8.8% over all DBM traffic and 13.6% over Fixed CPM DBM traffic.").

514 *See* Ravi Report, Section III.D.2.; *see also*, GOOG-AT-MDL-006218271, at -290 (01/06/2023) ("Project Poirot launched on 19 July 2017 globally (including in the US and EEA) and is still active today.").

515 Note that a deviation from a second price auction does not imply that an exchange was running first price auction. For example, Google makes references to deviations from second price auctions in various ways, such as "pseudo" second price auctions, and "soft-floor" auctions. *See* GOOG-DOJ-AT-02480255, at -256 (04/25/2017) ("The non-second-price auction may or may not be fully first-price, but it has at least some range of bids where the cost is an increasing function of bid…this is the amount paid by the impression with highest bids (for these pseudo-2nd price exchanges)"); *see also*, GOOG-DOJ-10806862, at -865 (04/25/2017) ("An exchange may not be fully first pricing…but may instead be first pricing within some range (e.g. soft floors).").

516 [redacted]

Google would send the lowered bids to other exchanges, collect data on the outcomes, and then pick a multiplier to shade advertisers' bids below their true values, choosing the multiplier that maximized the advertisers' "surplus" for each advertiser/exchange pair.[517] "Surplus" is the difference between an advertiser's value for the impression and the amount that it pays for the same impression.[518]

222. Although AdX did not run a "clean" second price auction, Poirot did not reduce DV360 bids into AdX because of a threshold requirement to trigger the program. In particular, if Poirot's bid reductions into a given exchange were expected to increase Google's calculation of advertiser surplus by less than 10 percent, the bids were not reduced on that exchange.[519] In multiple internal communications, Google employees acknowledged that AdX was not running clean 2nd price auctions.[520] However, because of the 10-percent threshold, AdX was not subject to bid reductions from Poirot while a number of rival exchanges experienced declines in advertiser spend from DV360, as I discuss in more detail in Section VI.C.2.[521]

[redacted]

517 GOOG-DOJ-10806862, at -866 (04/25/2017) ("Once the above model is fit separately for each exchange, we pick the x that maximizes surplus for each advertiser.").

518 GOOG-DOJ-12059682, at -682 (08/10/2018) ("Surplus is defined as value - cost. For Fixed CPM advertisers value = Bid.").

519 *See* Ravi Report, Section III.D.2. *; see also*, GOOG-AT-MDL-008842383, at- 390 (08/05/2023) ("These experiments…identified the multiplier that tends to maximize the expected surplus of each advertiser on each ad exchange. If a multiplier increased the expected advertiser surplus by less than 10 percent, then Poirot would not adjust the advertiser's bids into that ad exchange. The purpose of this 10-percent threshold was to avoid adjusting bids on second-price auctions that might erroneously appear to be non-second-price auctions due to noise in the data.").

520 Various Google employees identified its Sell Side DRS and RPO programs as evidence that AdX deviated from running true second price auctions. Recall that both of these programs were implemented in 2015, before Project Poirot was launched. *See, e.g.*, GOOG-DOJ-03725708, at -716 (04/2016) ("RPO must be carefully introduced to the market since it has been live since 2015 and moves Google away from a 2nd price auction"); *see also*, GOOG-DOJ-AT-00810221, at -221 (01/10/2019) ("I do know buyers like Criteo are already shaving their bid on our auction because on [sic] sell-side optimizations like Optimized Pricing. We have not been a true 2nd price auction for some time now."); *see also*, GOOG-AT-MDL-012500548, at -549 (03/11/2016) ("Chris LaSala…wrote:…I would like to work with PM, buy/sell, to look at how we would communicate the reality that our auction acts as a modified 2nd price auction. Things like RPO, Dynamic Rev Share and Boost in OPA all have the impact of optimizing the 2nd price in someway.").

521 GOOG-AT-MDL-008842383, at -391 (08/05/2023) ("Before Google transitioned to a Unified First Price Auction, Poirot determined that reducing bids into AdX did not increase expected advertiser surplus by more than the 10-percent threshold, so Poirot did not lower DV360 bids into AdX.").

223. For the first implementation of Poirot, Google calculated adjustments at the exchange-and-advertiser level.[522] Google did not include other impression features in this version of Poirot, despite recognizing that they may "[n]eed to consider differences between display and video," i.e. between different ad formats.[523] Later, the model was updated to also include the feature "bid bucket," i.e., the dollar amount of the bid.[524,525] In May 2018, Project Poirot was extended to Private Auctions.[526]

224. In September 2018, a new launch candidate was proposed to update Project Poirot in response to many auctions self-identifying publicly as first price auctions ("Project Poirot V2").[527] The main changes were to adjust the model to take the "auction type" as an input, as some exchanges self-identified as first price or second price, and remove advertiser as an input.[528] In addition, the algorithm more aggressively lowered bids; specifically, the floor for reducing the bid would drop

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[522] *See* Ravi Report, Section III.D.2.

[523] Google also considered (but chose not to integrate) other candidate features, including video/display, domain, country, mobile browser class, and bid bucket. *See* Ravi Report, Section III.D.2.; *see also*, GOOG-DOJ-10806862, at -865 (04/25/2017) ("Candidate query features:…Other features (is_video, domain, country, mobile browser class): different publishers or segments of the network may have different bid landscapes and different non-second-price mechanisms…Bid bucket…[Comment reads:] Need to consider differences between display and video as they have quite different price ranges.").

[524] *See* Ravi Report, Section III.D.2. The feature was launched by early 2018. *See* Ravi Report, Appendix F.1.

[525] Google documents show that, in the background, Google employees created a mapping of each exchange-advertiser pair to the surplus-maximizing multiplier that was passed as a bid adjustment. *See* Ravi Report, Section III.D.2. Values were updated nightly using seven days of historical data. *See* Ravi Report, Appendix F.1. Initial experiments—trials of the bid lowering program itself—indicated spend on non-clean second price auctions was decreased by 25 percent. Google's early experimental results from April 2017 confirmed that Poirot would push DV360 spend volume to AdX. *See also,* GOOG-DOJ-10208926, at -929 (05/15/2017) ("Impact on unclean exchanges in experiment…***revenue***[:]…***change*** [from control to experiment:] -24.85%[,] ***payout***[:]…***change*** [from control to experiment:] -25.36%") (emphasis in original) and at -927 ("5% experiment for 5 days (4/15 to 4/19)") and at -931 ("Impact factoring budget…[Change from] "Control" [to] "Experiment"[:] Adsense DBM revenue[:] 8.94%[.] Adx DBM revenue[:] 9.57%…Unclean 3p DBM revenue[:] -18.03%[.] Total DBM revenue[:] -2%").

[526] *See* Ravi Report, Appendix F.1; *see also*, GOOG-DOJ-AT-02434618, at -618 (07/16/2018) ("The expansion of Poirot to PA bidding (go/poirot-deal) launched May 23.").

[527] GOOG-DOJ-15743853, at -853 (09/06/2018) ("**Sent:** 9/6/2018…Subject:…Launched ariane 259738…ariane/259738 – Project Poirot with auction type signal[.] Summary:…In this launch candidate, we incorporate auction type query feature, lower the floor on bid shaving to 0.1, and revise the model to improve accuracy.") (Emphasis in original); *see also*, GOOG-DOJ-12059682, at -682 (08/10/2018) ("Poirot is a framework for bid shaving in non-second-price auction exchanges. It only applies to Fixed CPM DBM traffic. In this launch candidate, we incorporate auction type query feature, lower the floor on bid shaving to .1 and revise the model to improve accuracy. Total projected revenue loss is 1.26% while net revenue increases by 3.39%, which translates to +41$M annualized. Note: the original Poirot launch was twice as impactful… So, there is a good chance, we won't see much of the 1.26% gross revenue loss here either.").

[528] *See* Ravi Report, Appendix F.2.

from [redacted] to [redacted] (i.e., from [redacted] percent shading to [redacted] percent shading of original bid).[529] [redacted]. [530] Project Poirot continued through at least January 2023.[531]

225. Because Google owns both DV360 and AdX, Google had a particular incentive to reduce bids into rival exchanges and in that way provided AdX with an advantage. While DV360 was able to bid into rival exchanges, recall that Google would collect additional revenue if those impressions cleared through AdX specifically, due to AdX's 20 percent revenue share.[532] Particularly with rival exchanges using Header Bidding and Open Bidding, AdX competed head-to-head against bids submitted by rival exchanges.[533] Often, those bids from third-party exchanges originated from Google's own demand products, especially DV360.[534] Therefore, to the extent that Poirot resulted in DV360's bids on rival exchanges falling beneath those exchanges' price floors, AdX benefitted from Poirot, and rival exchanges were harmed by it.

226. As discussed above in Section VI.B, Google modified its sell side dynamic revenue sharing programs such that Project Poirot—a buy side program—did not reduce DV360's bids into

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529 [redacted]

530 *See* Ravi Report, Section III.D.2.

531 *See* Ravi Report, Section III.D.2.c.; *see also*, GOOG-AT-MDL-006218271, at -290 (01/06/2023) ("Project Poirot launched on 19 July 2017 globally (including in the US and EEA) and is still active today."). I note that Google's approach to bid reduction shifted over time. *See also*, Ravi Report, Section III.D.2.a.

532 *See* Ravi Report, Section III.C.; *see also*, GOOG-DOJ-05277697, at -697 (05/10/2018) ("Intuitively we know that moving $1 from DBM-3PE to DBM-AdX gets us a 20% revshare we didn't have before, so it should deliver a ton").

533 *See* Ravi Report, Section III.A.2 and Appendix C.5; *see also*, GOOG-DOJ-AT-01917966, at -989 (06/03/2020) (Graphic titled "Evolution of Ad Server Decision-Making" as of "2016" shows "Exchange 1[,]" "Exchange 2[,]" and "Exchange 3" feeding into "Header Bidding", which feeds into "Remnant / Indirect…price floor", which competes with "Exchange Bidding & AdX", resulting in "AdX" competing with "Exchange 1," "Exchange 2," and "Exchange 3").

534 *See* Ravi Report, Section III.D.1.; *see also*, GOOG-TEX-00085512, at -512 (03/16/2018) ("I am told regularly that DBM is the top buyer on every other exchange, so a huge chunk of publisher HB revenue is Google demand going outside our ecosystem and then coming back in via 3PE/HB.").

AdX.[535] In addition, Google documents indicate that Google ensured that RPO[536] did not cause Project Poirot to reduce bids submitted AdX.[537] One of Google's experiments showed that RPO could trigger DV360 to lower bids onto AdX.[538] In its internal discussions, Google engineers contemplated changing Poirot but ended up proposing a "watered down" version of the program that would make RPO undetectable to Poirot.[539]

VI.C.2. Impact of Project Poirot on Rival Exchanges' Scale

227. Google's experiments and internal analyses illustrate the effects of Project Poirot on outcomes for rival exchanges. An experiment prior to the launch of the first version of Project Poirot showed a decrease in DV360's impressions won on those rivals by 15.01 percent and ad spend by 20.52 percent; when restricted to "3p unclean exchanges," the declines in impressions and ad spend were 16.54 percent and 24.85 percent of DV360 traffic on rival exchanges, respectively.[540] Moreover, Google also found that Poirot would lead to higher spending by DV360 on AdX. In a

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535 *See* Ravi Report, Section III.D.4. and Section III.C.3..

536 In 2015, Google implemented a program that it called Reserve Price Optimization (RPO) which raised the floors that publishers or PASs submitted to an SSP. *See* Ravi Report, Section III.C.1.; *see also*, GOOG-DOJ-13227256, at -256 (03/24/2017) ("We would like to adjust the adx revenue share on a per-query basis before collecting buyers' bids, disclose the adjusted pre-revshare reserve price to buyers in the bid requests fairly, and make the auction a clean second-price auction."); *see also*, GOOG-DOJ-03725708, at -716 (04/2016) ("RPO must be carefully introduced to the market since it has been live since 2015 and moves Google away from a 2nd price auction").

537 *See* Ravi Report, Section III.D.; *see also,* GOOG-AT-MDL-B-002838050, at -051–52 (03/05/2018) ("The online RPO launch candidate we proposed has been watered down to the point that it's indistinguishable from vanilla adx auction (more aggressive tunings of online-RPO were detected by current implementation of Poirot, although still within tolerance intervals).").

538 *See* GOOG-AT-MDL-007393625, at -630–31 (01/10/2018) ("Other findings[:] AdX team is building RPO for AdX for bids higher than $5. The production Poirot model doesn't react to this but the launch candidate as illustrated in the figure below." The subsequent graph depicts alpha-relative surplus curves for advertisers with RPO, by bid bucket: "Figure: Modeled surplus for a canonical advertiser in a bid bucket surplus model on Adx based on background experiments with RPO. The highest bid bucket shows significant scope for surplus improvement.").

539 *See* Ravi Report, Section III.D.4.; *see also*, GOOG-AT-MDL-B-002838050, at -051–52 (03/05/2018) ("When buyers realize we're training [RPO] on bids, they may implement logic to strategically shade bids. DBM has a system called Poirot built for this purpose. The online RPO launch candidate we proposed has been watered down to the point that it's indistinguishable from vanilla adx auction (more aggressive tunings of online-RPO were detected by current implementation of Poirot, although still within tolerance intervals).").

540 GOOG-DOJ-13557023, at tab "Summary" (05/17/2017) ("**On 3p exchanges**…imps…-15.01%…revenue… -20.52%…**On 3p unclean exchanges**…imps …-16.54%…revenue…-24.85%") (emphasis in original). The results for "3p unclean exchanges" in GOOG-DOJ-13557023 are the same as those recorded in GOOG-DOJ-10806862, at -868 (04/25/2017).

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that, and then we did not have the ability to invest on the people side. In the people side, technology businesses are fundamentally driven by people - whether that's writing code, whether that is designing a product, whether that is going into, as we say, a partner or a customer and selling - the core investment for growth that we typically make is around people. We did not have the resources after that to be able to make the investments in people.").

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Page	Paragraph	Footnote	Original	Corrected	Reason
7	16	6	"ad.spend"	"ad spend"	Typo
9	19.b	.	"6.94 percent"	"6.24 percent"	Typo
9	19.b	.	"$31 million"	"$29 million"	Correction
11	22	10	"See, e.g., "Internet Advertising Revenue Report," PwC, iab, April 2023, https://www.iab.com/wpcontent/uploads/2023/04/IAB_PwC_Internet_Advertising_Revenue_Report_2022.pdf"	"See, e.g., "Internet Advertising Revenue Report," PwC, iab, April 2023, https://www.iab.com/wpcontent/uploads/2023/04/IAB_PwC_Internet_Advertising_Revenue_Report_2022.pdf, **at 15**"	Clarification
12	25	.	"The tools to run RTB auctions for the purchase and sale of online display ads **is** called…"	"The tools to run RTB auctions for the purchase and sale of online display ads **are** called…"	Typo
17	33	41	"(e.g., the average spend for each conversion should not exceed a pre-specified target).")."	"(e.g., the average spend for each conversion should not exceed a pre-specified target).") **(emphasis in original)**."	Clarification
19	34	47	"at 3968"	"at 3952"	Correction
23	43	71	"using machine algorithms"	"using machine **learning** algorithms"	Clarification
24	44	77	"no. 1 (**2014**)"	"no. 1 (**2015**)"	Typo
25	46	88	"EC '22: Proceedings of the **2023** ACM Conference on Economics and Computation **2023**"	"EC '22: Proceedings of the **23rd** ACM Conference on Economics and Computation"	Typo
25	46	88	"no. 1 (**2023**)"	"no. 1 (**2022**)"	Typo
25	46	90	"EC '22: Proceedings of the **2023** ACM Conference on Economics and Computation **2023**"	"EC '22: Proceedings of the **23rd** ACM Conference on Economics and Computation"	Typo
25	46	90	"no. 1 (**2023**)"	"no. 1 (**2022**)"	Typo
26	46	90	"(2023): 1–35, at 6"	"(2023): 1–35, at 6**–7**"	Clarification
26	46	91	"EC '22: Proceedings of the **2023** ACM Conference on Economics and Computation **2023**"	"EC '22: Proceedings of the **23rd** ACM Conference on Economics and Computation"	Typo
26	46	91	"no. 1 (**2023**)"	"no. 1 (**2022**)"	Typo
26	47	93	"See Lee Report, Section II.C.3. **and Section II.C.3.**, explaining…"	"See Lee Report, Section II.C.3., explaining…"	Typo
28	51	.	"Google Ad Manager ("GAM"), which includes a publisher ad **server, and** an ad exchange/SSP."	"Google Ad Manager ("GAM"), which includes a publisher ad **server and** an ad exchange/SSP."	Typo
32	59	132	"$\theta^1(x)$ "	"$\theta^l(x)$ "	Typo
36	68	143	"("we use the *market thickness* to represent the average number of ads competing for user impressions on an online advertising platform.") **(emphasis in original)**;"	"("we use the *market thickness* to represent the average number of ads competing for user impressions on an online advertising platform.");"	Correction
37	69	.	"to **auctions with few participants** that"	"to **less competitive auctions** that"	Clarification
38	70	154	"**955**–1025"	"**965**–1025"	Typo
38	70	157	"**955**–1025"	"**965**–1025"	Typo
51	88	205	"things that we **think… helps** model highest other bid, and then we build a machine learning model."	"things that we **think helps** model highest other bid, and then we build a machine learning model."	Typo
54	92	218	"leaving money on the **table. We** also have access"	"leaving money on the **table. …We** also have access"	Clarification
56	93	225	"1849–1864, at **1850**"	"1849–1864, at **1851**"	Typo
60	98	243	"209–218, at **217**"	"209–218, at **209**"	Correction
60	98	244	"209–218, at **217**"	"209–218, at **216**"	Correction
63	101	258	"24:8–26:**14**"	"24:8–26:**6**"	Clarification
64	101	260	"the **confident** interval would be 95 percent"	"the **confidence** interval would be 95 percent"	Typo
64	102	261	"(Cambridge: MIT Press, **2021**)"	"(Cambridge: MIT Press, **2020**)"	Typo
64	102	262	"(Cambridge: MIT Press, **2021**)"	"(Cambridge: MIT Press, **2020**)"	Typo
64	102	263	"(Cambridge: MIT Press, **2021**)"	"(Cambridge: MIT Press, **2020**)"	Typo
66	104	269	"and 189**–190**"	"and 189"	Clarification

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Page	Paragraph	Footnote	Original	Corrected	Reason
68	109	279	"at 3933"	"at 3933**–3934**"	Clarification
68	109	279	"(2017): 500–522."	"(2017): 500–522**, at 500, 510**."	Clarification
70	112	284	"**23:6**–24:6"	"**24:1**–24:6"	Clarification
70	112	.	"John Gentry of OpenX named personnel costs alongside infrastructure costs, and real estate costs as costs that need **to covered** in order to have the "ability to invest and grow the business.""	"John Gentry of OpenX named personnel costs alongside infrastructure costs and real estate costs as costs that need **to be covered** in order to have the "ability to invest and grow the business.""	Typo
71	113	286	"(09/09/2023)"	**No Date**	Correction
73	115	296	"247:17–248:**19**"	"247:17–248:**7**"	Clarification
84	130	313	"based on the analysis in **Professor Robin Lee's office**."	"based on the analysis in **the Lee Report**."	Clarification
95	140	.	"Indeed, since **2014**, Google consistently has a higher volume of impressions, higher win rate, and higher aggregate ad spending"	"Indeed, since **2015**, Google consistently has a higher volume of impressions, higher win rate **(since 2018)**, and higher aggregate ad spending"	Typo and Clarification
96	141	.	"since at least January **2015**"	"since at least January **2018**"	Typo
102	151	355	"GOOG-TEX-00034461, at -462"	"GOOG-TEX-00034461, at -462**–463**"	Clarification
102	152	356	"GOOG-DOJ-15564937, at -937**–938**"	"GOOG-DOJ-15564937, at -937"	Clarification
112	165		"James Avery of Kevel reported **to his colleagues** that"	"James Avery of Kevel reported that"	Correction
113	166	391	"at -095 (**02/01**/2021)"	"at -095 (**01/22**/2021)"	Correction
113	167	.	"Similarly, among ad networks, Google Ads' impressions and spend are more than 5 and 2 times larger than that of Criteo and FAN combined."	Similarly, among ad networks, Google Ads' impressions and spend are more than 5 and 2 times larger than that of Criteo and FAN combined **in many months**.	Clarification
114	169	.	"The **introduction** of Open Bidding by Google in 2018 allowed other exchanges to compete with AdX on a real-time basis, but with limitations."	"The **implementation** of Open Bidding by Google in 2018 allowed other exchanges to compete with AdX on a real-time basis, but with limitations."	Clarification
115	169	396	"189:5–190:**18**"	"189:5–190:**3**"	Clarification
120	182	.	"highest price"	"highest **historical average** price"	Clarification
120	182	.	"AdX could **still** use that competing header bid"	"AdX could use that competing header bid"	Clarification
124	188	434	"predicting bids, the parameter"	"predicting bids, **with** the parameter"	Typo
130	198	453	**Workpaper 9**, at tab Last Look.	**Conduct Effects Workpaper**, at tab Last Look.	Clarification
131	198	454	**Workpaper 9**, at tab Last Look.	**Conduct Effects Workpaper**, at tab Last Look.	Clarification
141	212	500	"GOOG-AT-MDL-B-001601271, at 273 ("Sell-side dynamic revshare: [l]aunched for +$**100**M revenue.") (emphasis in original)."	"GOOG-AT-MDL-B-001601271, at 273 ("Sell-side dynamic revshare: [l]aunched for +$**110**M revenue.") (emphasis in original)."	Typo
143	217	.	"For impressions, rival exchanges saw a decrease of 81.7 billion impressions, or 2.39 percent of annual impression volume **absence** the conduct."	"For impressions, rival exchanges saw a decrease of 81.7 billion impressions, or 2.39 percent of annual impression volume **absent** the conduct."	Typo
146	220	.	"Recall that in first price auctions, it is optimal for bidders to reduce their bids (Section **II.A.1**)."	"Recall that in first price auctions, it is optimal for bidders to reduce their bids (Section **II.C.1**)."	Typo
148	224	527	"improve **accuracy. Total** projected revenue loss"	"improve **accuracy... Total** projected revenue loss"	Clarification
152	229	552	"Deposition of John Gentry (OpenX), October 26, 2023, 21:15–21:22 ("Q. How, if at all, did the decrease in spending by DV360 on OpenX affect OpenX?…THE WITNESS: It was a devastating impact to the company, resulting in severe financial consequences. We had to execute a large layoff in December of 2018 and had a lot of negative effects as a result of that.")."	Switch with text in footnote 553.	Correction

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Page	Paragraph	Footnote	Original	Corrected	Reason
152	229	553	"Deposition of John Gentry (OpenX), October 26, 2023, 22:17–23 ("Our revenues went from - we were about 170 in 2017; 2018 we were about 160 because the first half of the year was strong; in 2019, we were down to about 120 million; and in 2020, the combination of difficulties we had had plus COVID took us down to about 87 - 87, 88 million in net revenue in 2020.")."	Switch with text in footnote 552.	Correction
152	229	.	"The CEO of OpenX, John Gentry, testified that OpenX's revenues fell from **160** million in 2017 to 120 million 2019."	"The CEO of OpenX, John Gentry, testified that OpenX's revenues fell from **170** million in 2017 to 120 million 2019."	Typo
154	232	564	"Poirot has actually been quite effective, resulting in DBM spending 7% more on AdX and reducing spend on most other exchanges.")"	"Poirot has actually been quite effective, resulting in DBM spending 7% more on AdX and reducing spend on most other exchanges.") **(emphasis in original)**"	Clarification
162	247	.	"introduction of **UPR** was attributable"	"introduction of **UFPA** was attributable"	Correction
165	252	.	"AdX's 6.48 percent gain in impressions translates to a loss of at minimum **50.9** billion impressions per year"	"AdX's 6.48 percent gain in impressions translates to a loss of at minimum **50.8** billion impressions per year"	Typo
191	290	690	"GOOG-AT-MDL-018528378, at -381 (03/02/2017) ("**Lost** of experiments!…Average ~120 per query")."	GOOG-AT-MDL-018528378, at -381 (03/02/2017) ("**Lots** of experiments!…Average ~120 per query").	Typo
C-1	3.a.ii.	3	"Letter from David R. Pearl to **Kelly Garcia**, September 8, 2023, 2."	"Letter from David Pearl to **Michael Freeman**, September 8, 2023, 2."	Correction
D-10	22	17	"Letter from Julie Elmer to John Hogan, August 19, 2022, 5–6**|8** ("	"Letter from Julie Elmer to John Hogan, August 19, 2022, 5–6 ("	Typo
D-12	28	25	"See GOOG-AT-MDL-008928566, at -583 (08/**03**/2017)"	"See GOOG-AT-MDL-008928566, at -583 (08/**23**/2017)"	Typo
E-2	2	.	"exchanges' bids **have the same variance** that is characterized **by the spread parameter**"	"exchanges' bids **have variance** that is characterized **by the same spread parameter**"	Clarification
E-21	42	21	"Letter from David Pearl to Michael J. Freeman, July 28, 2023 ("	"Letter from David Pearl to Michael J. Freeman, July 28, 2023**, 2** ("	Clarification
F-2	3	5	"John Rice, "11.2 Comparing Two Independent Samples", in Mathematical Statistics and Data Analysis, 3rd ed. (Duxbury: Thomson Brooks/Cole, 2007)."	"John Rice, "11.2 Comparing Two Independent Samples", in Mathematical Statistics and Data Analysis, 3rd ed. (Duxbury: Thomson Brooks/Cole, 2007)**, 421–444**."	Clarification
F-5	11	12	("Rule of Thumb[:] The basic formula is n=16/Δ^2 (2.3).").	("Rule of Thumb[:] The basic formula is n=16/Δ^2 (2.3) **where Δ=(μ_0-μ_1)/σ=δ/σ (2.4)**.").	Clarification
F-5	11	12	N/2=16 (p_p (1-p_p))/(p_1-p_0)	N/2=16 (p_p (1-p_p))/(p_1-p_0)**^2**	Correction

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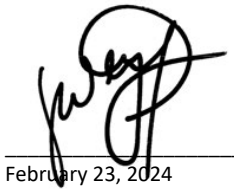
Page	Paragraph	Footnote	Original	Corrected	Reason
142	216	509	This is close to the estimate we use from GOOG-DOJ-AT-02427435, at -435 of **6.58** percent.	This is close to the estimate we use from GOOG-DOJ-AT-02427435, at -435 of **8.6** percent.	Clarification



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